Encapsulated dental-derived mesenchymal stem cells in an injectable and biodegradable scaffold for applications in bone tissue engineering.

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Public Summary:
These findings demonstrate for the first time that immobilization of periodontal ligament stem cells and gingival mesenchymal stem cells in alginate microbeads provides a promising strategy for bone tissue engineering.

Scientific Abstract:
Bone grafts are currently the major family of treatment options in modern reconstructive dentistry. As an alternative, stem cell-scaffold constructs seem to hold promise for bone tissue engineering. However, the feasibility of encapsulating dental-derived mesenchymal stem cells in scaffold biomaterials such as alginate hydrogel remains to be tested. The objectives of this study were, therefore, to: (1) develop an injectable scaffold based on oxidized alginate microbeads encapsulating periodontal ligament stem cells (PDLSCs) and gingival mesenchymal stem cells (GMSCs); and (2) investigate the cell viability and osteogenic differentiation of the stem cells in the microbeads both in vitro and in vivo. Microbeads with diameters of 1 +/- 0.1 mm were fabricated with 2 x 10(6) stem cells/mL of alginate. Microbeads containing PDLSCs, GMSCs, and human bone marrow mesenchymal stem cells as a positive control were implanted subcutaneously and ectopic bone formation was analyzed by micro CT and histological analysis at 8-weeks postimplantation. The encapsulated stem cells remained viable after 4 weeks of culturing in osteo-differentiating induction medium. Scanning electron microscopy and X-ray diffraction results confirmed that apatitic mineral was deposited by the stem cells. In vivo, ectopic mineralization was observed inside and around the implanted microbeads containing the immobilized stem cells. These findings demonstrate for the first time that immobilization of PDLSCs and GMSCs in alginate microbeads provides a promising strategy for bone tissue engineering.